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Physiological response to cycling with variable versus constant power output

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Background

- Traditional cycling training has generally been performed with constant power output (Faria et al., 2005)

- However, cycling is a sport that is stochastic of nature (Palmer, Noakes & Hawley, 1994, Jeukendrup, Craig & Hawley, 2000)

- The ability to tolerate variations in power is relevant for performance (Ebert, Martin, Stephens & Withers, 2006)

Study aim

- To investigate physiological response to cycling with variable versus constant power output as well as perceived exertion to these power conditions.

- To investigate if variations in power output which span above lactate threshold differ from variations below lactate threshold.

Material and methods

Day 1 – baseline testing

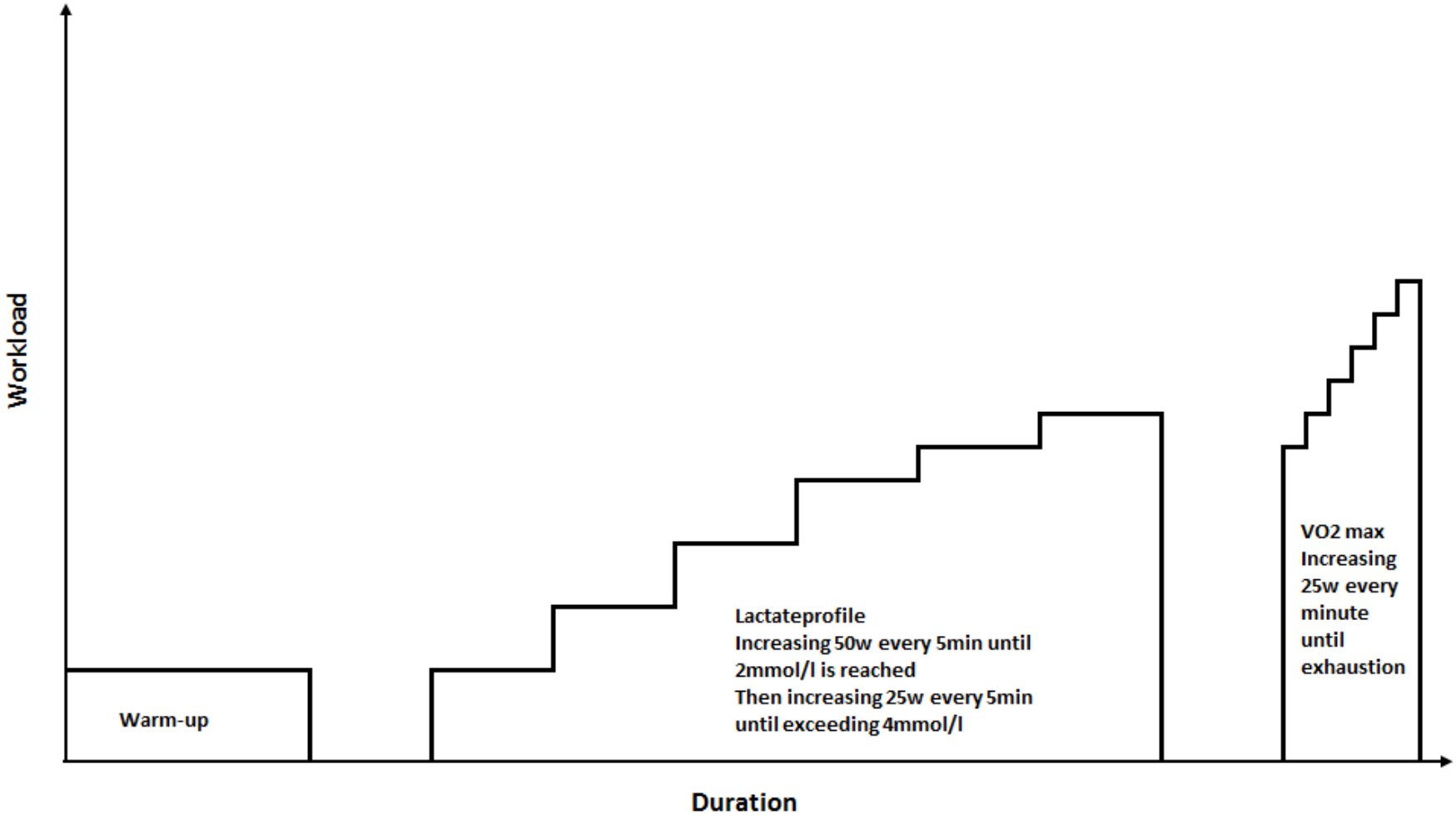
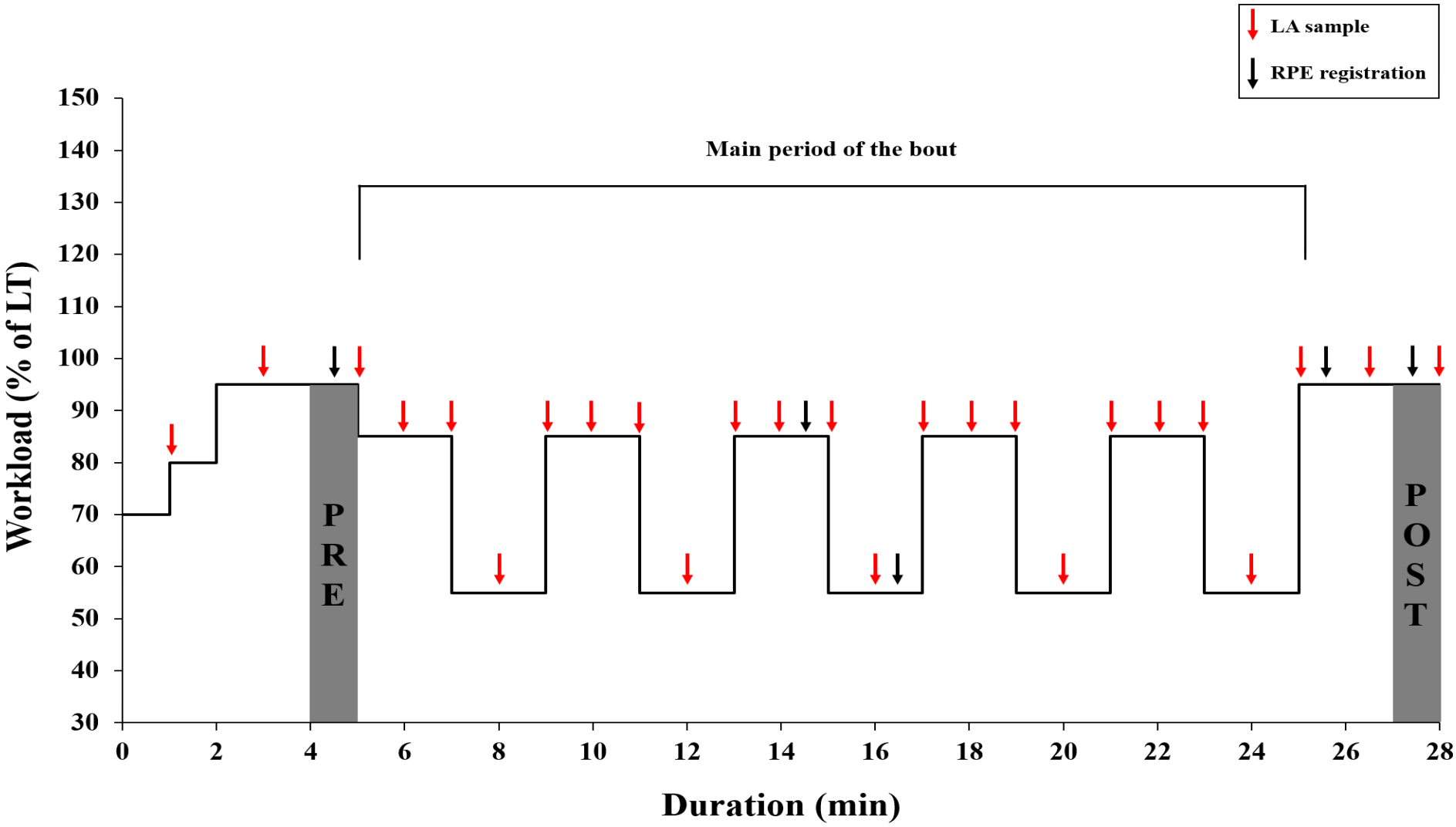


Table 1. Characteristics of the 15 included cyclists (mean ± SD)

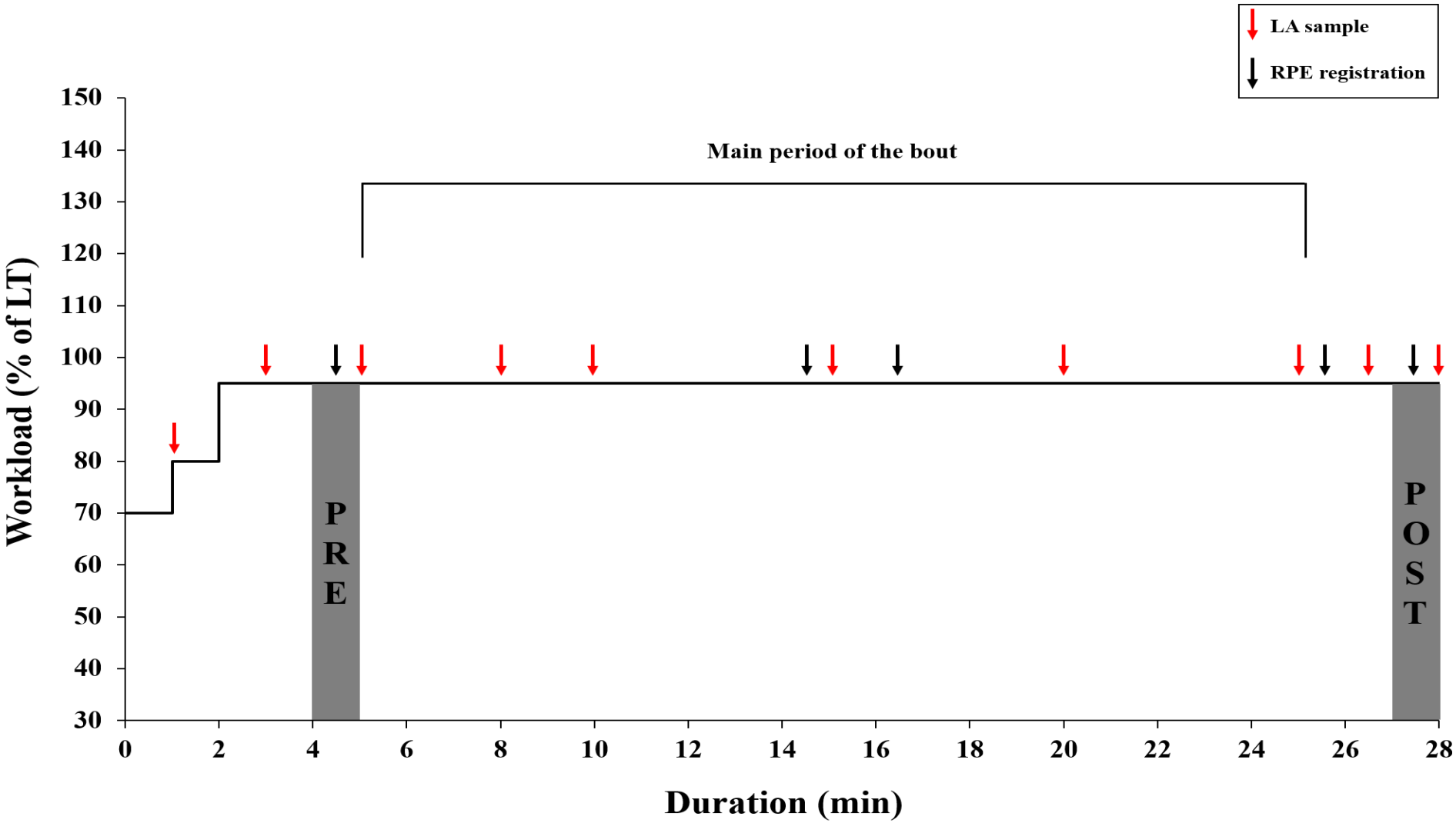
Age (years)	24.9 ± 7.6
Weight (kg)	72.6 ± 7.3
Height (cm)	182.2 ± 7.1
VO_{2max} (ml/kg/min)	72.9 ± 5.1
VO_{2max} (L/min)	5.3 ± 0.4
LT (W)	310.5 ± 21.7
LT (W/kg)	4.3 ± 0.4
PPO (W)	415.0 ± 28.0
PPO (W/kg)	5.8 ± 0.5
Number of races last season	33.9 ± 17.2
Training volume last season (hours)	691.0 ± 186.6

LT, lactate threshold; PPO, peak power output; VO_{2max}, maximal oxygen uptake

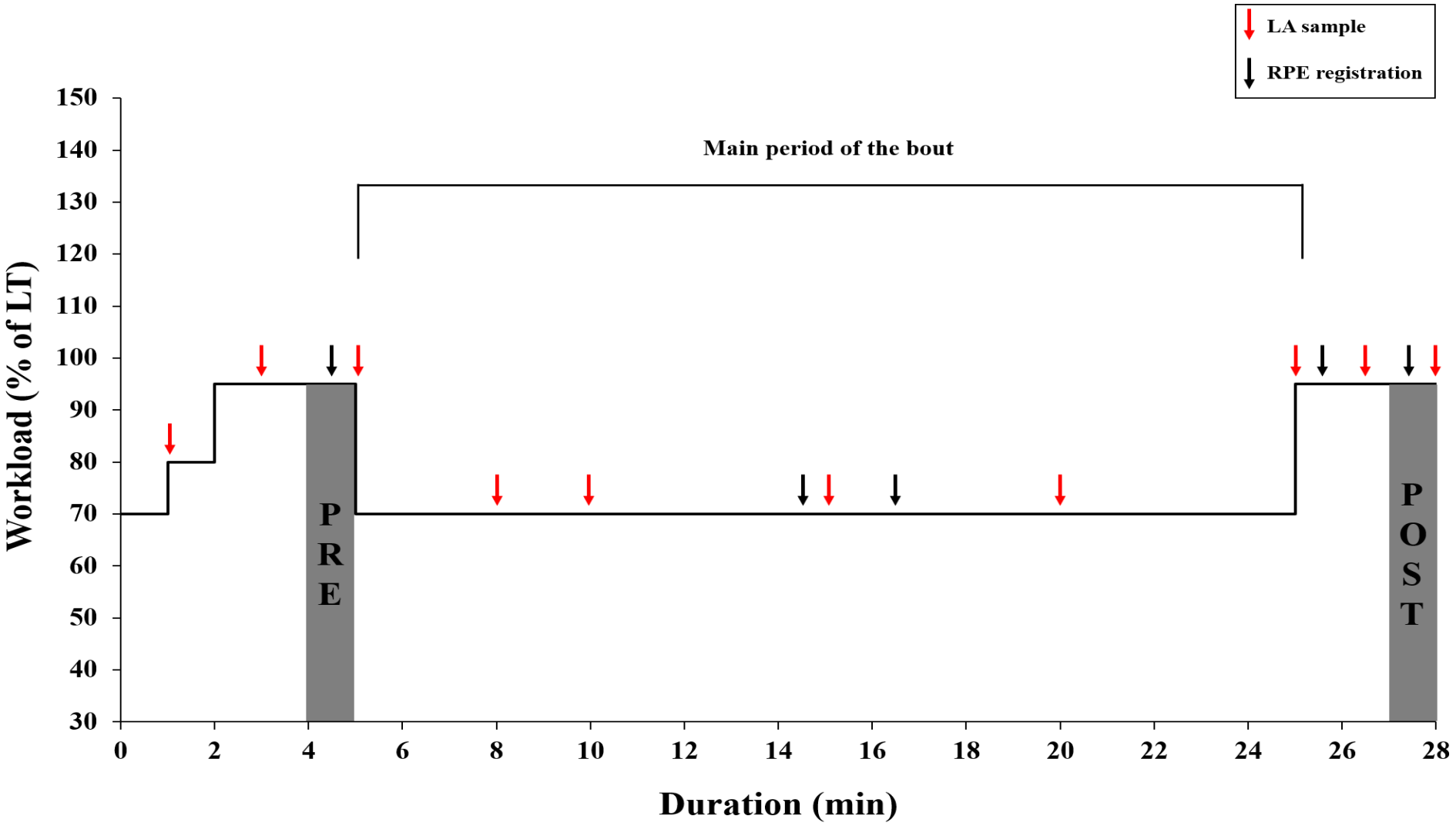
Day 2 & 3 – main testing



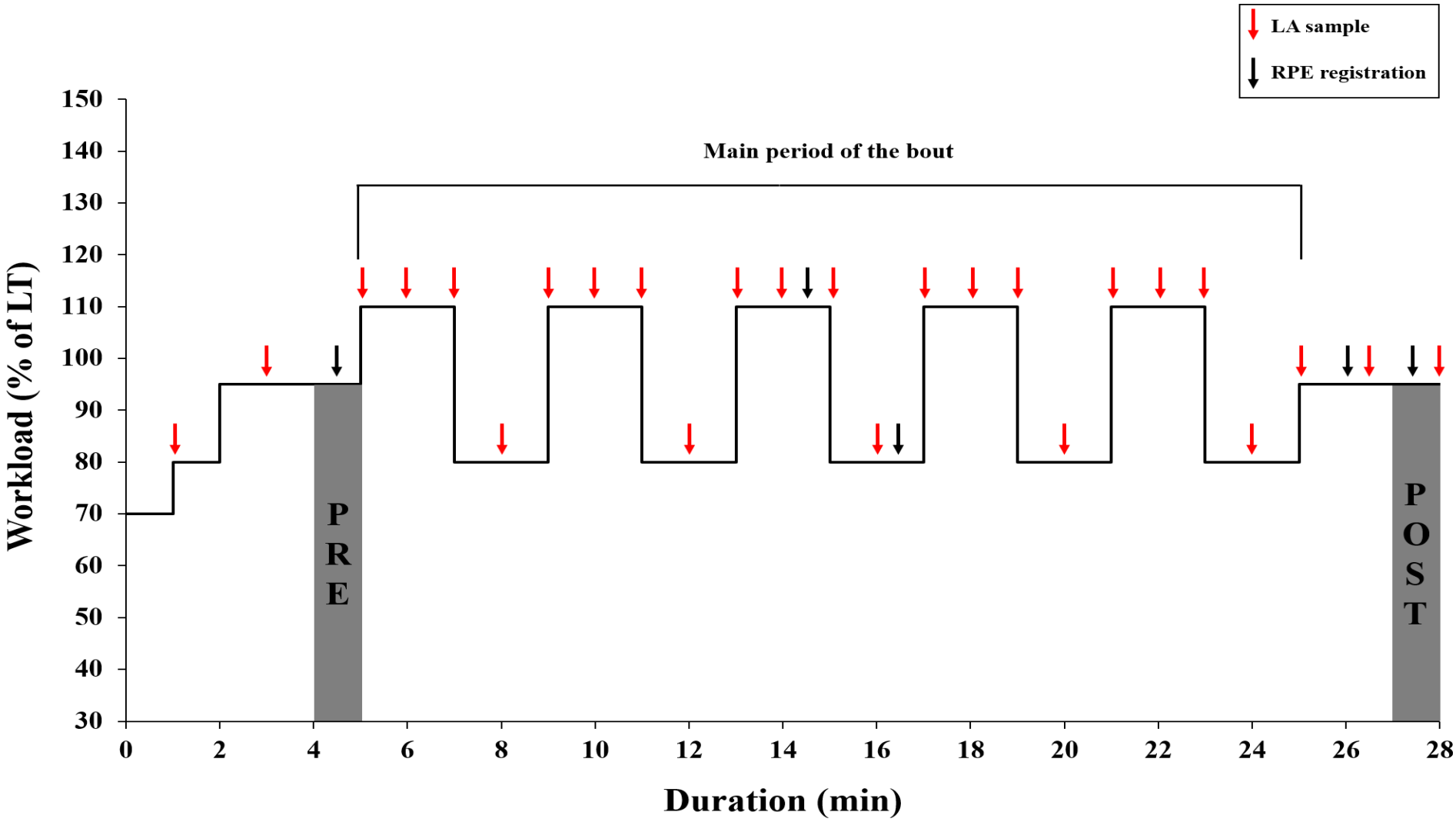
Day 2 & 3 – main testing



Day 2 & 3 – main testing

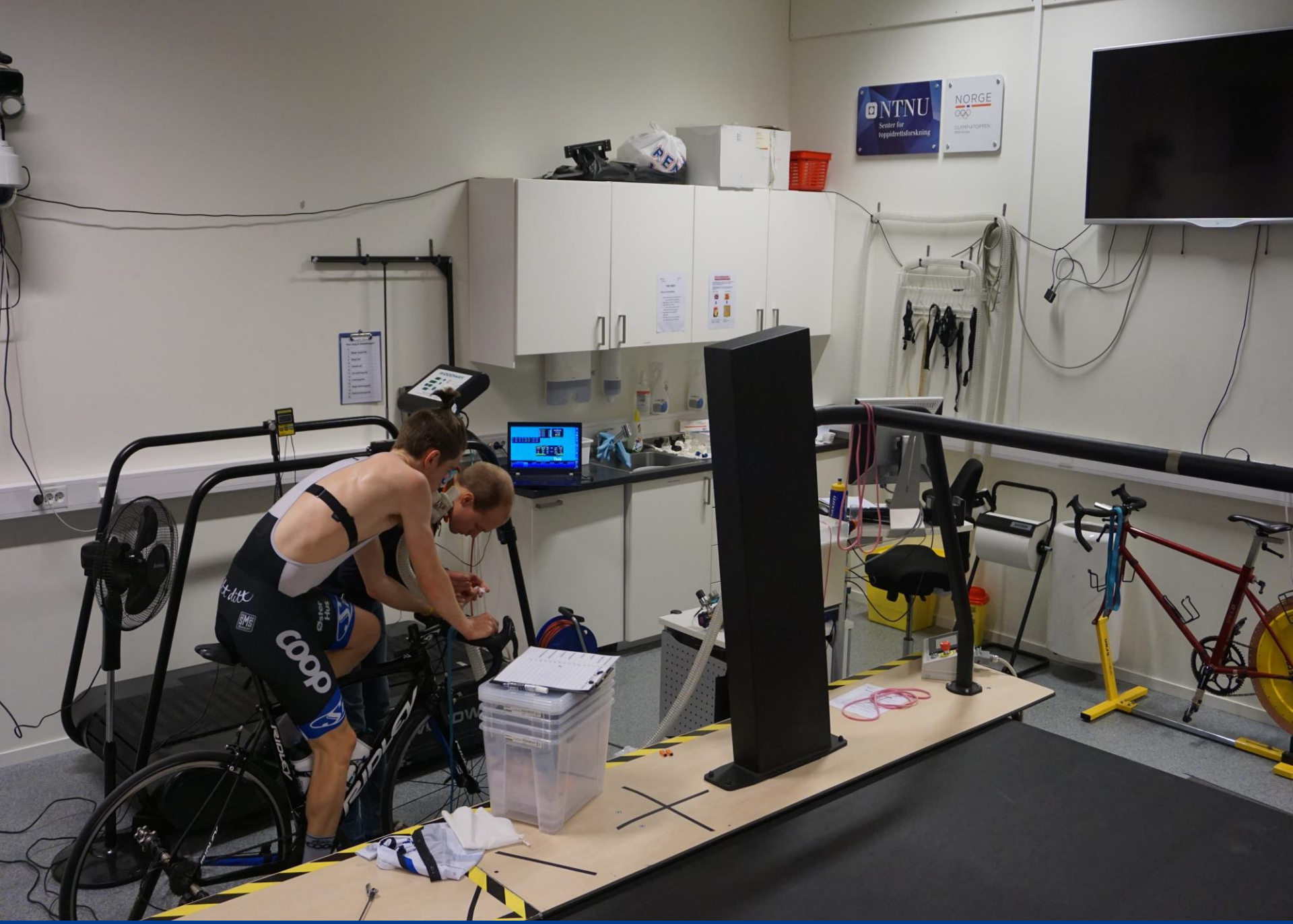


Day 2 & 3 – main testing



Material and methods

- **Equipment and measurements**
  - Oxygen consumption (Jaeger Oxycon Pro)
  - Blood lactate concentration (Biosen)
  - Heart rate (Garmin)
  - Workload and pedalling frequency (Computrainer)
  - Rate of perceived exertion (Borg's scale)
- **Statistical analysis**
  - Paired samples t-test
  - Two-way repeated measures ANOVA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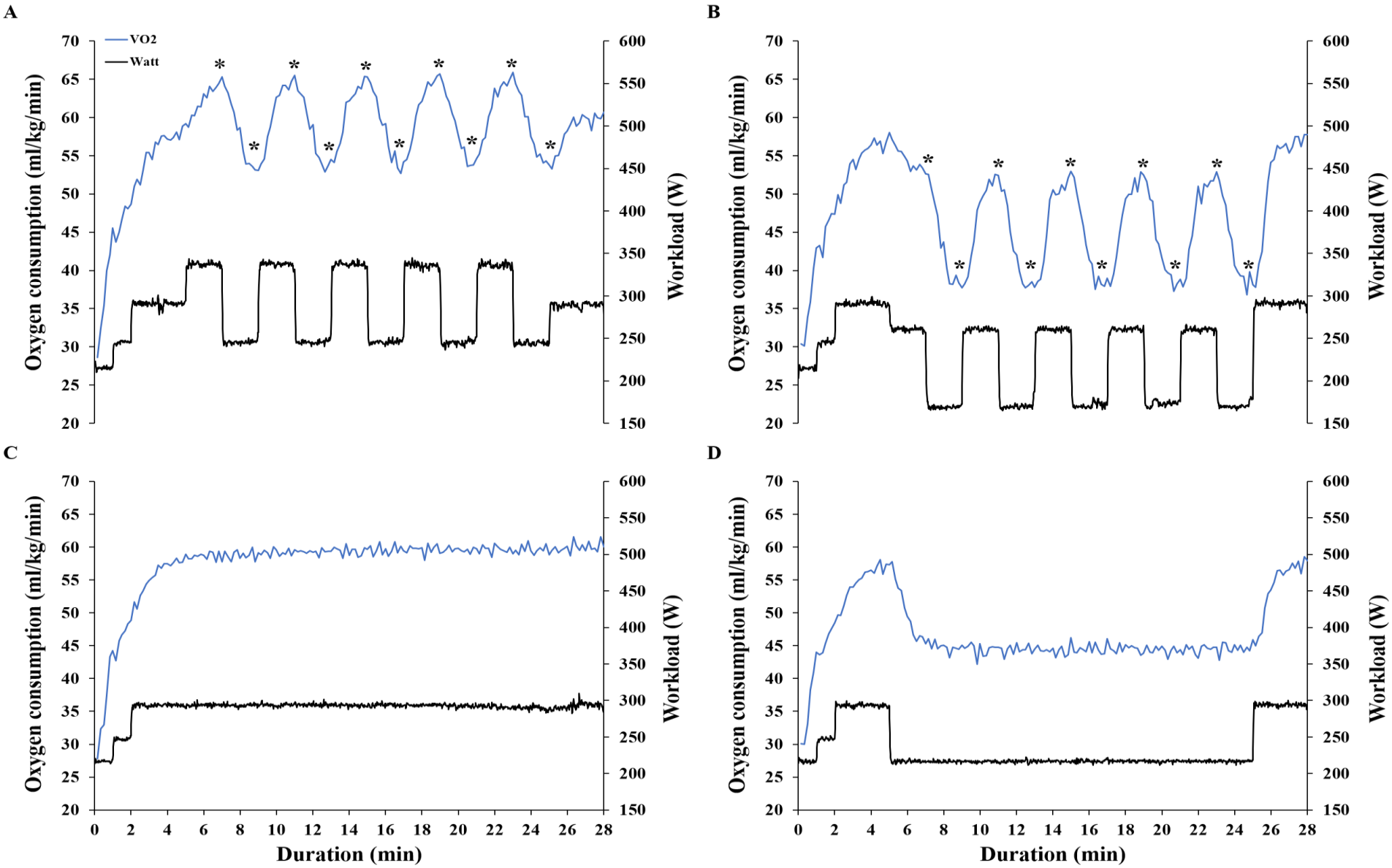
Results – oxygen consumption



* indicate a significant difference in oxygen consumption during the variable power segment compared to the corresponding constant power segment, $p < 0.05$.

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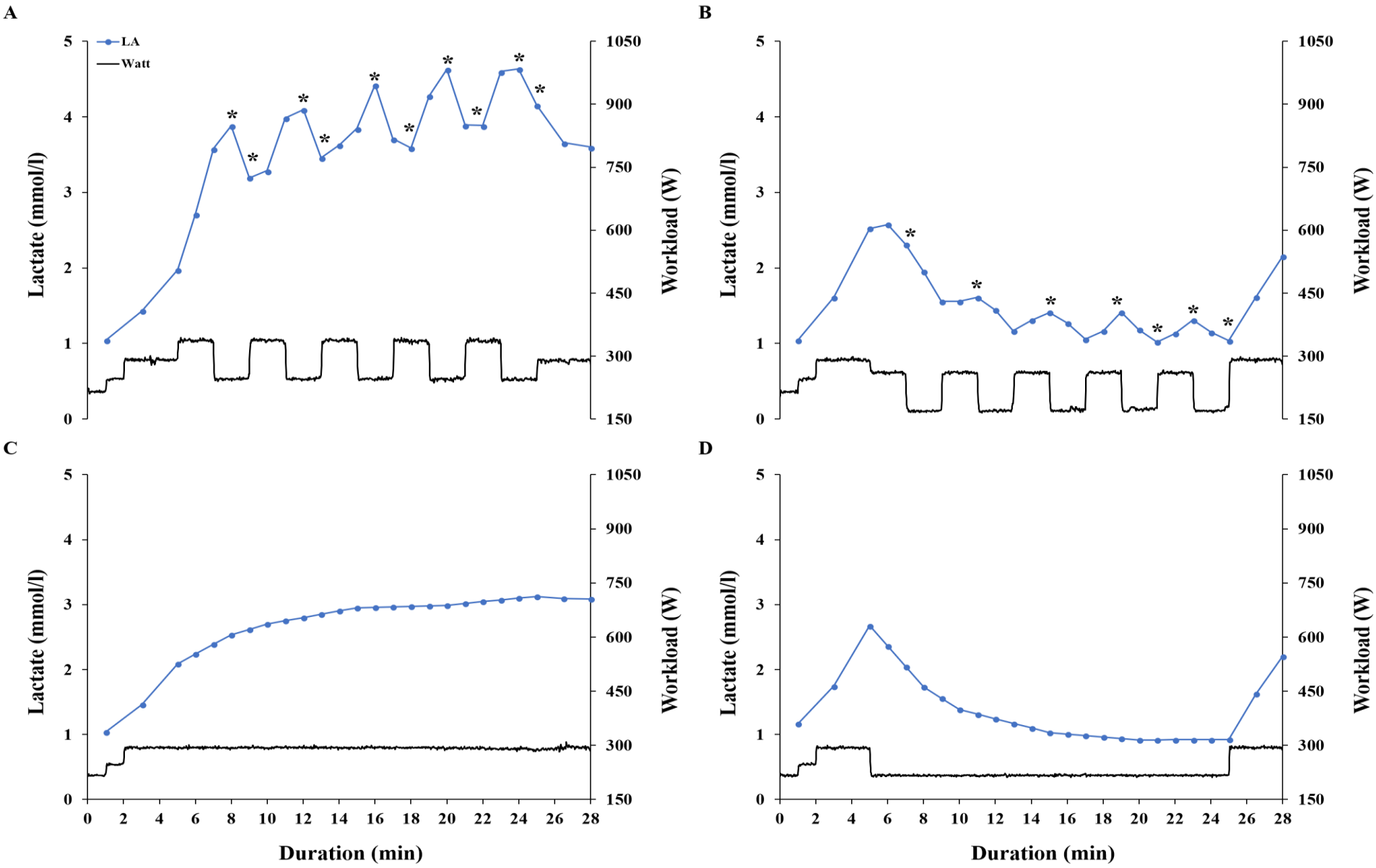
Results - lacate



* indicate a significant difference in lactate during the variable power segment compared to the corresponding constant power segment, $p < 0.05$.

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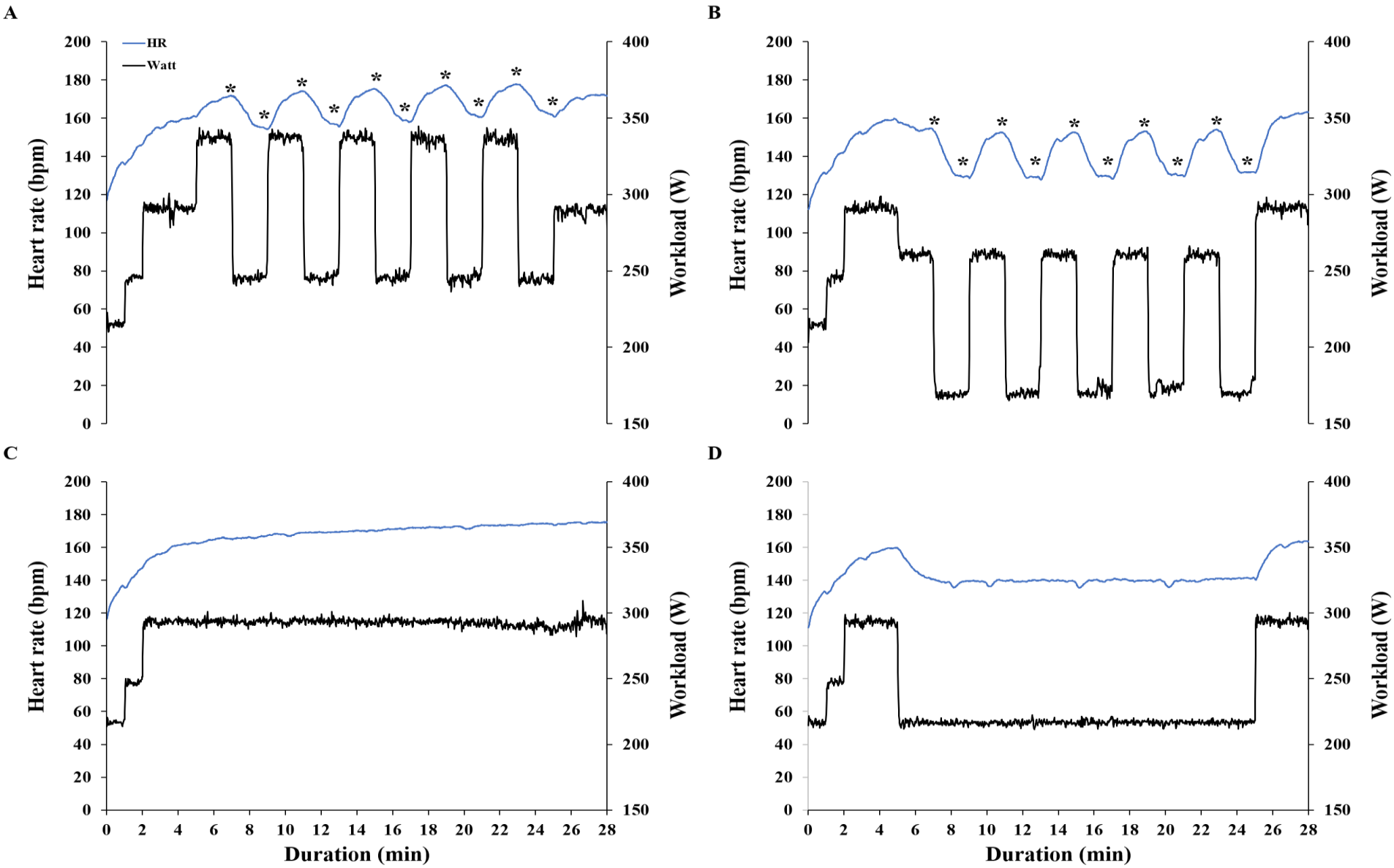
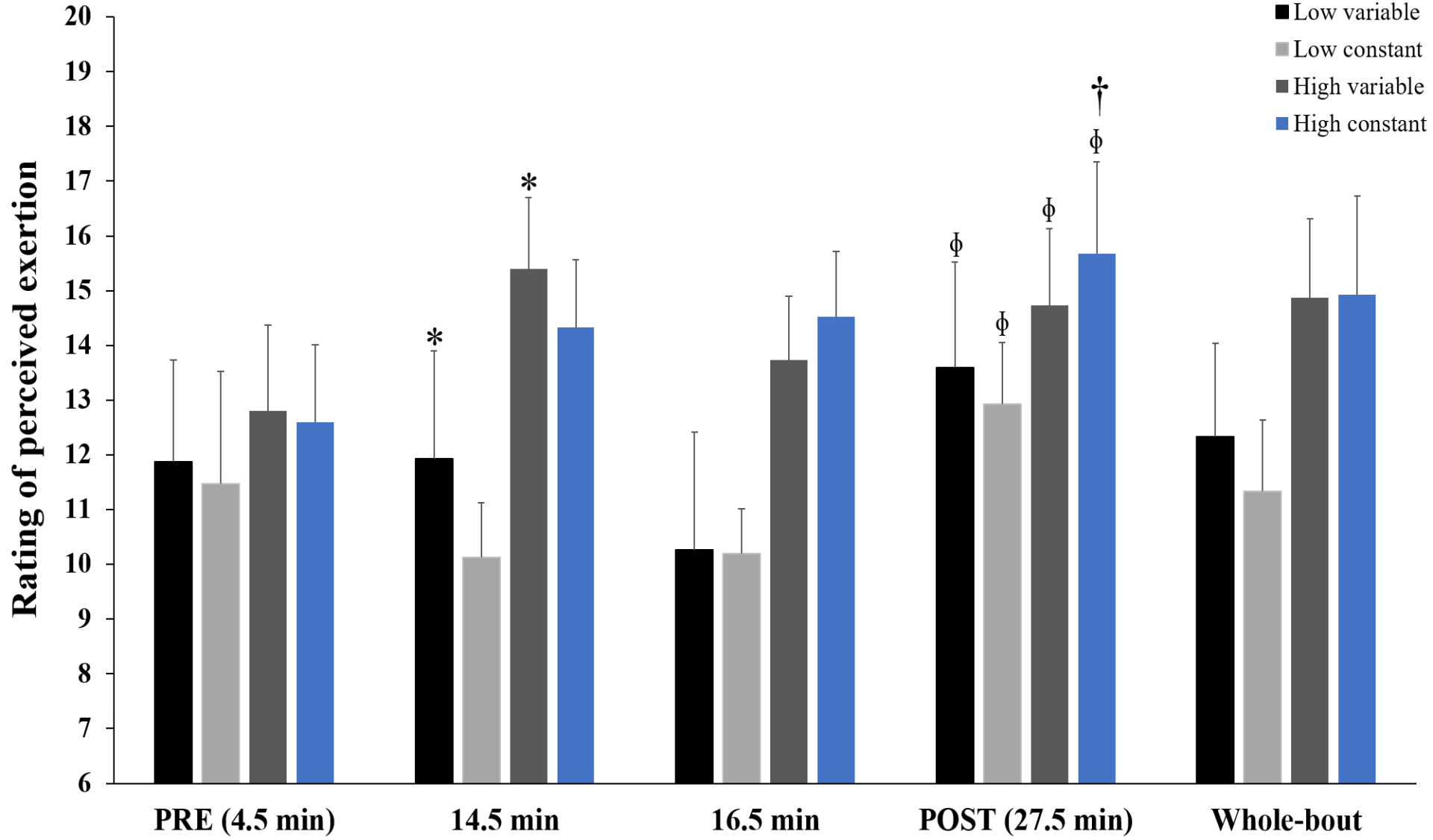
Results – heart rate



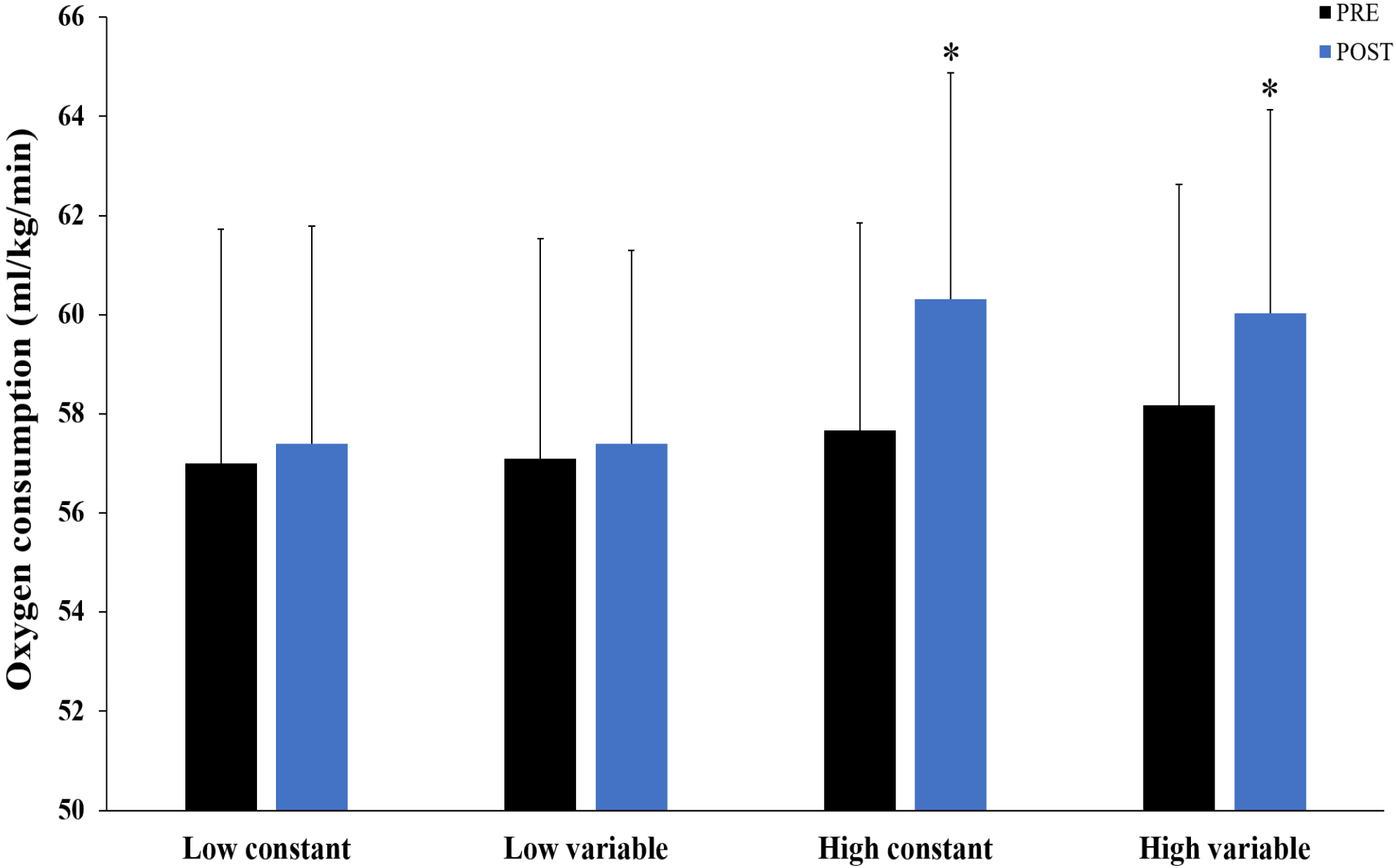
* indicate a significant difference in heart rate during the variable power segment compared to the corresponding constant power segment, $p < 0.05$.

Results – rate of perceived exertion



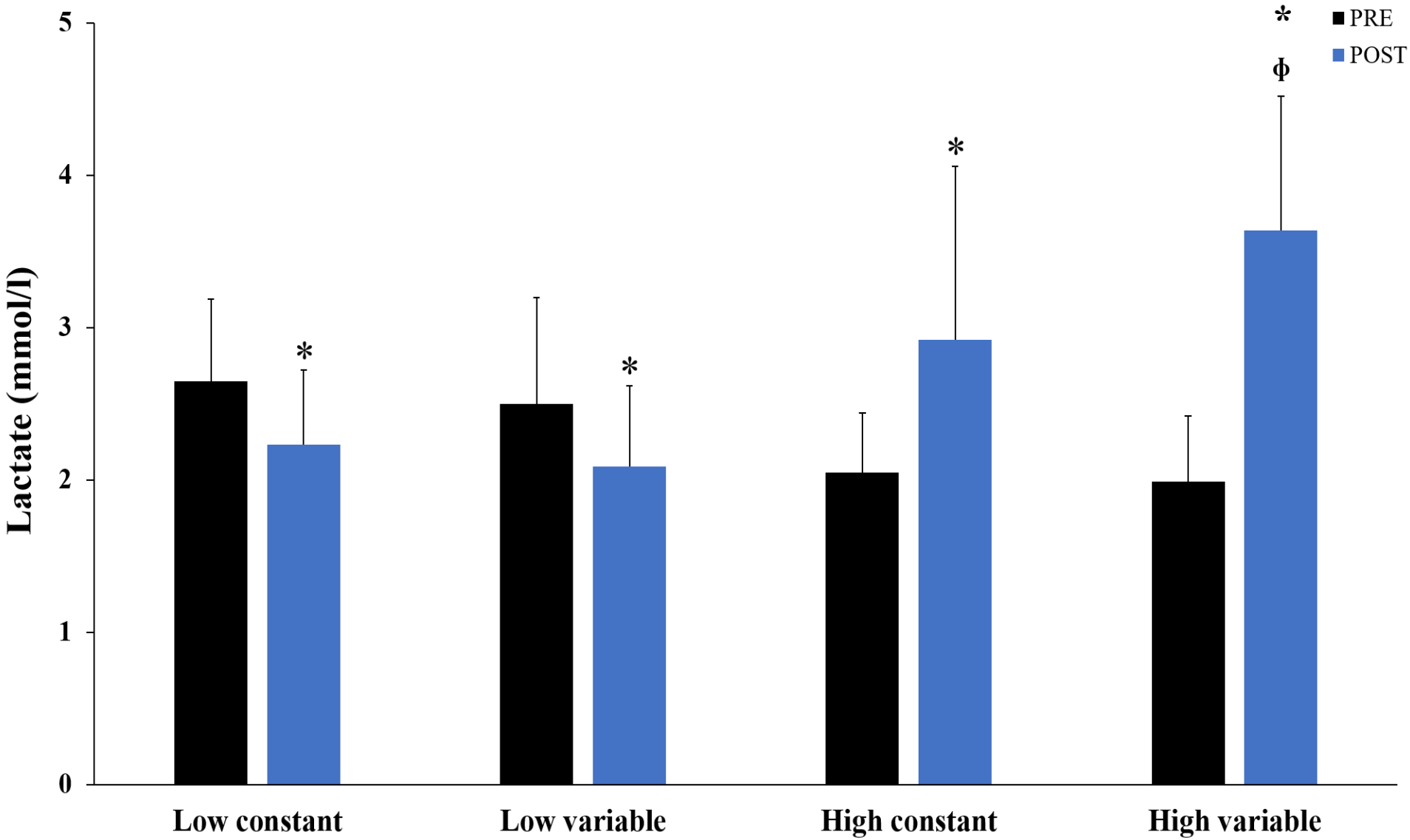
* indicate a significantly different rating of perceived exertion during variable power compared to constant power at the same intensity, $p < 0.05$.
ϕ indicate a significant change in rating of perceived exertion from PRE to POST, $p < 0.05$.
† indicates a significantly greater change in rating of perceived exertion from PRE to POST during constant power compared to variable power at the same intensity, $p < 0.05$.

VO_2 changes from PRE to POST



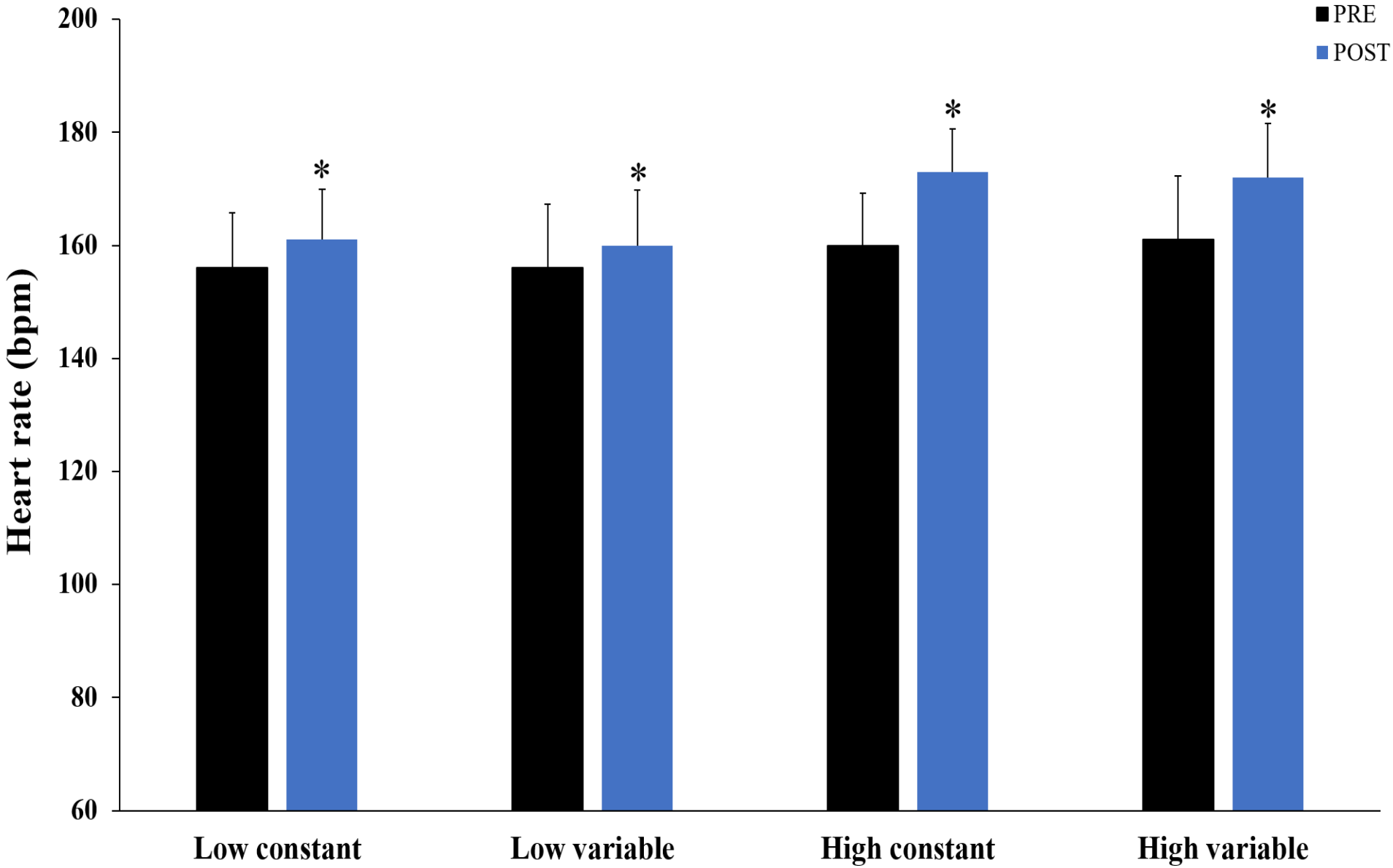
* indicate a significant change in oxygen consumption from PRE to POST, $p < 0.05$.

Lactate changes from PRE to POST



* indicate a significant change in lactate from PRE to POST, $p < 0.05$.
ϕ indicates a significantly greater change in lactate from PRE to POST during variable power than during the constant power bout at the corresponding intensity, $p < 0.05$.

Heart rate changes from PRE to POST



* indicate a significant change in oxygen consumption from PRE to POST, $p < 0.05$.

Discussion

- Difference in VO_2 and lactate between VP and CP at high intensity was expected
- First study to investigate physiological response to VP vs. CP in a cohort of elite competitive cyclists
- Results differ slightly from previous studies (Liedl, Swain & Branch, 1999, Brickley et al., 2007)

Conclusion

- Small differences in physiological response to VP and CP
- These results could be used as a tool in designing training programs
- Further research is needed

References

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- Brickley, G., Green, S., Jenkins, D. G., McEinery, M., Wishart, C., Doust, J. D., & Williams, C. A. (2007). Muscle metabolism during constant- and alternating-intensity exercise around critical power. Int J Sports Med, 28(4), 300-305. doi:10.1055/s-2006-924354

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- Palmer, G. S., Hawley, J. A., Dennis, S. C., & Noakes, T. D. (1994). Heart rate responses during a 4-d cycle stage race. *Med Sci Sports Exerc, 26*(10), 1278-1283.

Thank you for your attention!